Vigorous Young-Stand Development
On Green Diamond's California Timberlands

Dan Opalach, Ph.D., RPF #2459
Timberlands Investment Manager
Green Diamond Resource Company
June 8, 2012

Background

To become certified under the FSC-US Forest Management Standard ("Standard"), Green Diamond must demonstrate that its use of even-aged silviculture is consistent with the following indicator which is contained in Appendix C of the Standard (Forest Stewardship Council 2010):

Indicator 6.3.g.1.b *Even-aged silviculture may be employed where: 1) native species require openings for regeneration or vigorous young-stand development, or 2) it restores the native species composition, or 3) it is needed to restore structural diversity in a landscape lacking openings while maintaining connectivity of older intact forests.*

Indicator 6.3.g.1.b ("Indicator"), as written, contains a number of "or" clauses. Thus, to show consistency with the Indicator it is sufficient to show that Green Diamond's use of even-aged silviculture is consistent with at least one of the "or" clauses. The focus of this paper is to demonstrate that the native species that Green Diamond relies upon for its reforestation program require openings for vigorous young-stand development.

The Standard defines even-aged silviculture as follows (see page 78):

Even-aged silviculture: *Silvicultural systems in which stands of trees of roughly the same age and size are grown and harvested simultaneously. Even-aged systems may involve intermediate entries that remove some trees before the final, or "regeneration" harvest, when a new even-aged class of trees is established. A regeneration harvest is designed to remove all or most of the trees within a defined age/size class, or to convert a stand containing trees having a variety of ages, sizes, or species to a more uniform stand. The timing of the regeneration harvest is termed the "rotation age" of the timber stand. Even-aged silvicultural systems include clearcut, seed-tree, shelterwood, two-age silviculture, and variable retention systems. Even-aged management units may contain more than one age/size class of trees on the site at any one time for silvicultural reasons or environmental enhancement. For instance, a variable retention system typically retains 10-25% of the vegetative cover present before harvest on site and intermixed with the new even-aged stand, to maintain structures and functions important for wildlife. Classic shelterwood and seed tree cuts retain mature trees from the harvested stand during the establishment of the next crop of trees, but these are taken out during a "removal" harvest to leave one age/size class for future management.*

This definition of even-aged silviculture encompasses several sections from California's Forest Practice Rules ("FPRs"). First, the FPRs describe the various regeneration methods used in even-aged management including clearcutting, seed tree, and shelterwood methods (14 CCR 913.1). Second, the FPRs list the intermediate treatments (commercial thinning and sanitation salvage) that can be employed to manage crop tree density in an even-aged stand (14 CCR 913.3). Finally, the FPRs define variable retention as an approach to harvesting "based on the retention of structural elements or biological legacies (trees, snags, logs, etc.) from the pre-harvest stand for integration into the post-harvest stand to achieve various ecological, social and geomorphic objectives" (14 CCR 913.4(d)). To be clear, the FPRs do not "lump" variable retention into the even-aged management methods. Rather it is in a separate section of the rules labeled Special Prescriptions.

Green Diamond's approach to even-aged management has evolved considerably over the years. Back in 1990 harvest units[1] averaged 60 acres in size and watercourse and lake protection zones ("WLPZs") only encumbered 3% of Green Diamond's timberland. Timber Harvesting Plans ("THPs") were only 22 pages in length and Green Diamond had one biologist on its staff.

In 2012, over 20 years later, harvest units average 29 acres size. THPs routinely exceed 200 pages in length and we have over 40 biologists, botanists, and geologists on staff. WLPZs, habitat retention areas, unstable geologic features, and other areas that cannot be clearcut encompass 25% of Green Diamond's ownership. A typical THP, nowadays, results in a landscape that has lots of structure upon the completion of timber operations (see Figure 1).

[1] A harvest unit is comprised of clearcut patches and adjacent watercourse buffers and/or habitat retention areas.

Figure 1. WLPZs occupy significant portions of the landscape in some areas. This image shows the buffers associated with Class II watercourses in the Little River watershed. WLPZs are principally managed using uneven-aged silviculture. This image was taken from Pollnow Peak in May 2001.

Given the widespread occurrence of areas that need to be managed for values other than timber it is important to note that Green Diamond uses both uneven-aged and even-aged regeneration methods on its California timberlands. A recent examination of THPs approved since the implementation of Green Diamond's Aquatic Habitat Conservation Plan (July 2007) showed that 75% of Green Diamond's timberlands are currently managed using even-aged silviculture and 25% are managed using uneven-aged silviculture or no harvest prescriptions. Uneven-aged prescriptions are used in areas such as WLPZs, habitat retention areas, or geologically unstable areas.

Green Diamond's Intensive Forest Management Program

For decades Green Diamond has managed its California timberlands such that the large majority of the stands that exist today are even-aged. That said, the way in which we manage our even-aged stands has evolved considerably over the years. Prior to the mid-1960s Green Diamond relied on natural regeneration to restock cut over timberlands. In

areas that contained a lot of redwood, this approach worked quite well given redwood's ability to sprout from stumps. But most harvest units did not contain enough redwood trees to solely rely on stump sprouts for stocking purposes, nor was the frequency and distribution of natural regeneration that germinated from seed sufficient to achieve acceptable stocking over most stand and site conditions.

Recognizing that significant improvements in forest productivity could be achieved by investing in silvicultural treatments, the company hired its first silviculturist, Jim Rydelius, in 1965 (Rydelius, personal communication). At first Jim used aerial seeding to supplement natural regeneration but he soon convinced the company to invest in a containerized nursery (in Korbel, California) to produce seedlings so he could use artificial regeneration, where needed, to restock harvest units. Over time Jim started redwood and Douglas-fir tree improvement programs which featured the installation of numerous test sites to evaluate the performance of plus trees and their progeny. Eventually Jim built a tissue culture lab at the Korbel containerized nursery to clone redwood plus trees. The lab is still in operation and produces approximately 750,000 redwood clonal plantlets annually for our reforestation program.

Our Intensive Forest Management ("IFM") program was initiated in 1974 to improve the survival, growth, and development of seedlings and stump sprouts. At that time treatments consisted of prescribed burning, reforestation, scarification, aerial applications of herbicides, pre-commercial thinning, and forest fertilization. These are largely discretionary investments and therefore subject to curtailments during difficult economic periods. For example, pre-commercial thinning, scarification, and forest fertilization treatments were temporarily halted in the early '80s due to the severe recession that was occurring in the United States.

Green Diamond's IFM program has evolved considerably over the years. This evolution is the result of research (both in-house and at universities), new laws, rules, and regulations, effectiveness monitoring, social pressures, markets for products, financial analyses, biotic influences, and other factors. These days Green Diamond's IFM foresters focus on:

- ***Site Preparation and Hazard Abatement***—Biomass harvesting is the primary method for reducing the fire hazard associated with logging slash. Our contractor picks up the logging slash and grinds it into hog fuel which is then delivered to the wood-burning power plants in the region. The slash on approximately 1,000 acres is treated annually using this method.[2] In addition to biomass harvesting Green Diamond also relies on pile burning to eliminate accumulations of logging slash. Pile burning is the preferred method in those areas that are not economical to conduct biomass harvesting operations. Going forward we expect to treat approximately 1,000 acres annually using this practice. Many of these acres are located in our Klamath Operations area, which is geographically isolated from the

[2] Cal Fire Forest Practice Inspectors routinely conduct inspections of active biomass operations. In a recent Notice of Fire Hazard Inspection a Cal Fire forester noted that "the work performed by this company is a significant benefit to the prevention of damaging wildfires" (McCray 2010).

wood-burning power plants. Lastly, if we have no alternative, we will use a broadcast burn to remove the slash from a problematic harvest unit. It must be emphasized that broadcast burning is our treatment of last resort. We would much rather conduct a biomass harvesting operation or burn piles than conduct a broadcast burn.

- ***Reforestation***—90% of the clearcut acres harvested by Green Diamond require artificial regeneration to rapidly restock the site with desirable conifer species. At a minimum, the California Forest Practice Rules ("FPRs") require that 55% of the plots in a regeneration survey are stocked. In order to ensure compliance with the stocking provisions of the FPRs as soon as possible, Green Diamond's IFM foresters predominately plant large, healthy, 2-year-old nursery stock at densities sufficient to ensure that regeneration surveys indicate that 75% of the plots are stocked.[3] Planting 2-year-old stock accelerates site occupation (Smith 1962) and reduces the need for subsequent vegetation management treatments. The quantities of trees that are planted on any given site depend on the frequency and distribution of redwood stump sprouts and other naturally occurring conifer seedlings. If a site has an abundance of sprouting redwood stumps it may not be necessary to plant any trees to achieve Green Diamond's stocking objectives. On the other hand, if the site has no redwood stump sprouts and seedling survival may be problematic, our foresters will plant up to 450 trees per acre to achieve our stocking objectives.

- ***Vegetation management***—Herbicides are no longer applied aerially. Instead all herbicide applications are ground based. The most common prescription calls for workers to carry 3- to 5-gallon backpack sprayers and then systematically walk through units and apply herbicides directly to the foliage of problematic brush species. WLPZ buffers, habitat retention areas, and other protected sites are not treated. A small percentage of the acreage we plant (about 17%) is treated with a pre-emergent herbicide which is broadcast over the harvest unit. It should be noted that herbicides are not applied programmatically. Additionally, Green Diamond's foresters periodically take water samples to make sure the Best Management Practices ("BMPs") we use are appropriately guarding against chemicals getting into watercourses.

  Each area to be considered for treatment is inspected by an IFM forester to make sure the unit contains hardwood and/or brush species that are impacting the growth and development of potential crop trees. It's noteworthy that only about 50% of our redwood harvest units require a vegetation management treatment. Thanks to stump sprouts and rapid artificial regeneration where needed, many units achieve full stocking and free-to-grow status without the need for a vegetation management treatment. In addition to herbicides Green Diamond may,

[3] On high elevation Douglas-fir sites and mixed conifer sites we use 1-year-old planting stock. It is very difficult for Green Diamond to plan for harvesting operations in these areas given current market conditions. When we do harvest, however, we want to get the units restocked as soon as possible so we use 1-year-old seedlings produced at our containerized nursery in Korbel.

on occasion, control unwanted vegetation with chainsaws or other hand tools. Such manual treatments are primarily used in those situations where the harvest unit has a hardwood or brush component that is too big to spray. Such treatment may also be combined with a pre-commercial thinning of the conifers to space out the crop trees.

The percentage of harvested acreage treated by herbicides has decreased markedly over the past several years. This reduction is due to the use of imazapyr which (1) can be applied at an earlier stand age and (2) is more effective than a tank mix of 2,4-D and triclopyr (the herbicides it replaced) and thus eliminates the need for a second treatment.

Green Diamond envisions a future where herbicide treatments are needed a lot less to produce free-to-grow redwood stands. This future condition is the result of Green Diamond's commitment to plant high quality redwood clonal stock and seedlings on all sites that are capable of supporting redwood over the long-term. With redwood uniformly distributed throughout the harvest units of the future, much of the regeneration will be composed of redwood sprouts that will out-compete the brush and hardwood species typically found in north coast forests. The primary treatments needed in the future to produce high quality timber stands dominated by redwood will be precommercial thinning and commercial thinning. These thinnings will ensure that the growth potential of each unit is allocated to an optimal number of trees.

The IFM program discussed above usually results in well stocked, free-to-grow stands by age five. In fact, monitoring surveys[4] show that 88% of our redwood stands are free-to-grow by age five. Very few stands require additional treatments (beyond age five) to achieve free-to-grow status by age ten. Green Diamond's objective is to get 100% of its redwood stands in a free-to-grow condition by age ten. Vistas packed with trees are commonplace along Green Diamond's forest roads (see Figure 2).

[4] Green Diamond monitors every young stand at age 5. IFM foresters establish transects through each stand and measure the trees on 10 1/100-acre plots. These surveys help the IFM forester (1) assess the effectiveness of IFM treatments, (2) determine the need for additional treatments, and (3) estimate stand attributes for the company's inventory database.

Figure 2. This is a young stand on the BM-1300. Forest stands in this area are typically free-to-grow by age five and well stocked with redwood clones, Douglas-fir seedlings, and other coniferous species.

Recently Green Diamond surveyed 17 ten-year-old stands to obtain additional data to help calibrate the growth and yield model that is used to update the forest inventory and prepare long-term management plans.[5] The model Green Diamond uses is called FPS which is the acronym for the Forest Projection and Planning System. FPS is discussed in detail below. The diameter distribution from one of the ten-year-old stands is shown in Figure 3.

[5] The monitoring data that is collected on five-year-old stands does not include DBH information, only tree heights. To calibrate the FPS model we needed a data set that included DBH and height measurements on all trees. A decision was made to collect the data on ten-year-old stands because such stands would have a substantial number of trees that would be tall enough to have measureable breast height diameters.

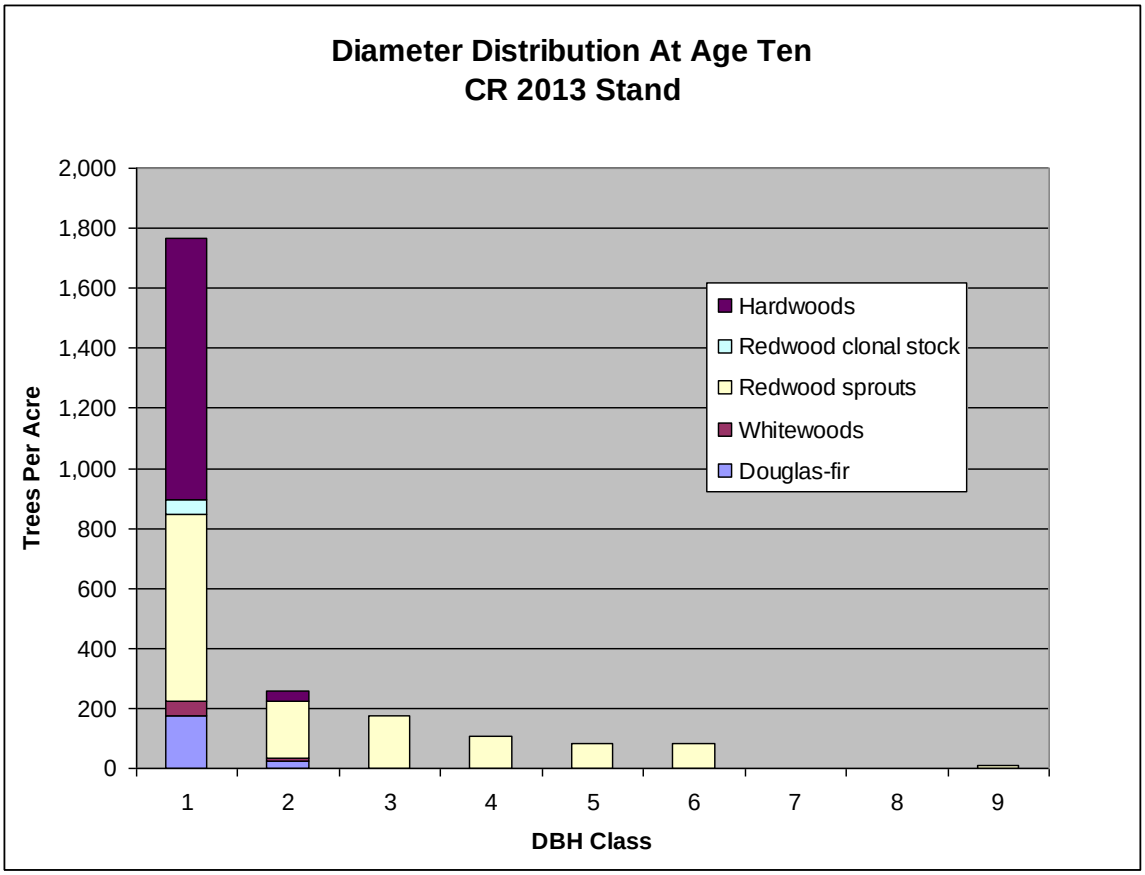

Figure 3. This chart shows the diameter distribution for a ten-year-old stand (covertype ID 821903) in the Little River tract just off the CR 2013 road.

The stand shown in Figure 3 is estimated to have 2,482 stems per acre with a diameter at breast height ("DBH") of 1 inch or greater. Over half of these stems are redwood sprouts (1,271 per acre) and 906 are hardwoods, primarily tanoak. The balance of the stocking is Douglas-fir, whitewoods (grand fir and western hemlock), and redwood clonal stock. It is noteworthy that this stand received two vegetation management treatments and still contains a significant number of hardwood stems in the 1 inch DBH class. In order to maximize the board foot yields from this stand at rotation age, Green Diamond pre-commercial thinned ("PCT") this unit in 2011. Unthinned, FPS estimates that the yield for this stand at age 50 will be about 41 MBF/acre. With the PCT treatment, FPS estimates that the yield will be 50% greater.

The plot data from the 17 ten-year-old stands show that the average density for this sample is 1,249 trees per acre (all species) over 1 inch in DBH. We are in the fortunate position of having exceptionally well stocked stands to manage for timber and other resources for decades to come based on the results obtained from our IFM program over the years. These data also demonstrate that Green Diamond's stands contain a wide variety of tree species and should not be characterized as "monocultures".

Growth and Yield Modeling

Green Diamond currently uses the Forest Projection and Planning System ("FPS"), developed by the Forest Biometrics Research Institute ("FBRI"), for inventory tracking and growth modeling. Green Diamond's California Timberlands Division has been a member of the FBRI since January, 2005.[6] FPS has been implemented for Green Diamond with a certified calibration library developed for us by Dr. James Arney, President and founder of the FBRI. The main features of this library that distinguish it from the standard FPS California Redwood Library are:

- Redwood is the index species, rather than Douglas-fir.
- Inclusion of old-growth redwood, old-growth Douglas-fir, and other old-growth whitewoods as separate species, which have been calibrated for zero growth.
- Inclusion of several generic species, notably 'other whitewoods' and 'other hardwoods', for compatibility with our legacy data.
- The default taper equations for redwood and Douglas-fir have been modified by Dr. Arney to duplicate the board-foot tree volumes as specified by the volume equations published in the Co-op Redwood Yield Research Project, Research Note No. 9. These were the same volume equations on which our proprietary growth and yield models were based.

When Green Diamond converted from the legacy proprietary growth and yield model to FPS in 2006, the company converted all legacy cruise data (some dating as far back as 1976) to FPS format, then grew all those cruised stands to December 31, 2005, using FPS. The resulting cruised inventory differed by only -0.1% (conifer and hardwood) from the inventory as grown using the legacy proprietary growth and yield models. The cruised conifer inventory decreased by 1.9% while the cruised hardwood inventory increased by 12.0%.

Uncruised stands were converted to FPS as they were represented in the legacy inventory system at the time of conversion, *i.e.*, as they were on December 31, 2005. These stands, as well as the cruised stands, are updated annually for growth using FPS. At the end of each year, we compare our inventory estimates (depletion) with production figures for each unit that was harvested. This comparison has been done annually since 1982. Over that time, total conifer depletion and production differ by less than one percent. This rigorous comparison is required under corporate policies governing financial accounting for depletion and forest management planning. Green Diamond will continue to make such comparisons on an annual basis in order to verify the accuracy of the inventory system.

As a further verification of the growth rates in the FPS library, Green Diamond provided FBRI with our legacy permanent-plot data, which had been the basis for calibration of our proprietary model. Approximately 500 1/5-acre plots were established across the

[6] Green Diamond's Northwest Division, headquartered in Shelton, Washington, is also a member of FBRI. Additionally, Dr. Dan Opalach, Green Diamond's Timberlands Investment Manager, was elected to FBRI's Board of Directors in November 2010. Dr. Opalach is still on the Board and is serving as its Chairman.

ownership between 1969 and 1976 and remeasured every four years until 2005. FBRI used FPS to simulate the growth of these plots from their earliest measurements and compared the simulated to actual growth of individual trees. FBRI concluded that the current FBRI library did an excellent job of simulating actual growth, and that modifications to the library were not needed based on Green Diamond's legacy permanent plot data. FBRI also conducted comparisons of growth as projected by our legacy growth and yield model and by FPS, and found close agreement between the two.

In order to provide a better local calibration going forward, especially with respect to effects of clumpiness, Green Diamond, in consultation with FBRI, established 30 new permanent plots in 2006 and 2007, each 0.75 acre in size, distributed across the ownership and representing the full range of habitat types, stocking levels, and species compositions. Later in 2007, we began stem-mapping the plots, completing this process in 2008. Remeasurement of these plots will be conducted, as recommended by FBRI, when the height growth differential reaches 20 feet. Green Diamond intends to maintain these plots through multiple remeasurement cycles, updating the calibration of the FPS library after each set of remeasurements.

Long-Term Sustained Yield Based on Even-Aged Management

Green Diamond's even-aged management practices lead to increases in conifer harvest and growth (see Figure 4) and conifer inventory (see Figure 5) over the next 100 years. If Green Diamond were to implement selection management, harvest levels would decline precipitously (see Figure 6).

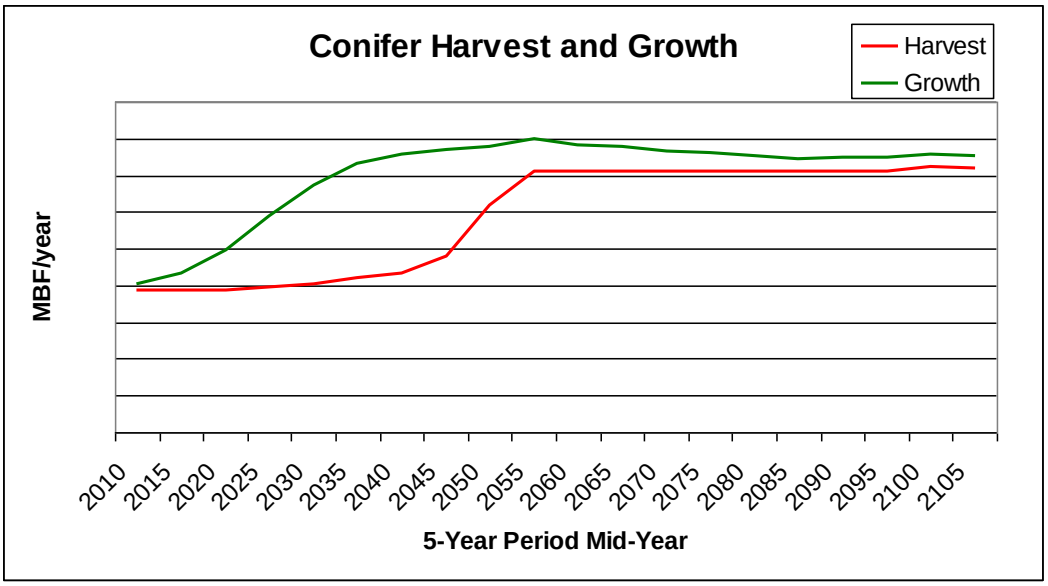

Figure 4. Conifer Harvest and Growth by 5-Year Periods, 2008-2107, as shown in Green Diamond's current Option (a) document which was approved in 2009. The Option (a) document is attached to every THP and is used to demonstrate compliance with certain sections in California's Forest Practice Rules.

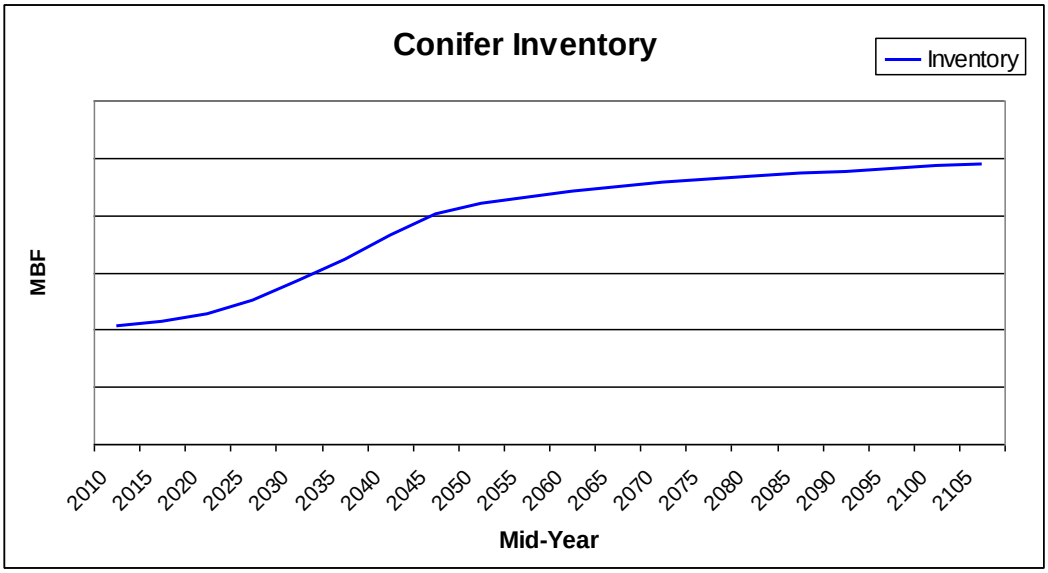

Figure 5. Conifer Inventory by 5-Year Periods, 2008-2107, as shown in Green Diamond's current Option (a) document.

Regime	Years 1 - 15 Avg Annual Harvest MMNLS	Years 16+ Avg Annual Harvest MMNLS
Clearcut	150	322
Commercial Thinning/Clear	212	281
Seed Tree	145	317
Variable Retention	143	310
Shelterwood	141	306
Selection	118	83

Figure 6. Selection management of Green Diamond's timberlands would result in reduced harvest levels. This analysis utilized the FPS long-term planning module to evaluate each of the regimes.

Review of the Literature

Redwood sprout regeneration is hampered by an overstory. Fritz (1951) was probably the first author to comment on this characteristic of redwood. To better appreciate the impact of an overstory on regeneration it will be instructive to compare the reproduction obtained with uneven-aged management and the reproduction obtained with even-aged management. Helms and Hipkin (1996) reported on the growth of redwood for ten years following treatment under various uneven-aged silvicultural methods. They reported that there were 209 trees (mostly stump sprouts) that grew into the two inch diameter class on 287 1/10-acre permanent plots.[7] That's equivalent to 7 trees per acre over the ten-year period. That's a very small amount compared to the average of 539 trees per acre that exceeded two inches in diameter on the 17 ten-year-old stands that Green Diamond recently surveyed (see above).

Lindquist (1996) also compared the redwood regeneration with no canopy versus a range of overstory levels from three studies on the Jackson State Demonstration Forest. A portion of his Table 4 is reproduced below:

Table 4. Average values for dominant and codominant trees at Whiskey Springs (20 years old) and Caspar Creek (19 years old).

Treatment	Age (years)	Ave. Diameter (inches)	Ave. Height (feet)
Caspar Creek Clearcut	19	10.9	51.9
75% Overstory Removal Whiskey Springs	20	3.1	26.3
50% Overstory Removal Whiskey Springs	20	1.4	12.2

Lindquist summed up Table 4 by saying "*statistical analysis is not necessary to see differences at Whiskey Springs and Caspar Creek*." The data in the table show that the regeneration growing in the clearcut areas at Caspar Creek have diameters three times bigger and two times taller than the best regeneration growing in an understory at Whiskey Springs.

Results from other studies are consistent with those reported above. Adams et al. (1996) compared the growth rates of regeneration in uniform (single-tree) and group (1/4- to 4-acre clearcuts) selection silvicultural systems and found that the uniform system "*seems to lack the ability to assure the rapid growth of regeneration afforded under the group selection* (small clearcut) *system*." Barrett (1988) established treatment plots in stands

[7] A small number of these permanent plots were from uncut control areas (<10%). The paper did not contain enough information to sum up the ingrowth on the treated plots only. Hence the per acre figures shown above most likely understate the ingrowth on treated plots by a small amount. It's unfortunate that the Helms and Hipkin study site did not contain 100% overstory removal treatment blocks.

subjected to various levels of overstory removal and concluded "*the harvest system that provides the greatest sprout growth is the clearcut system*." Finally, O'Hara and Berrill (2009) said that "*redwood coppice systems require relatively severe overstory treatments to provide sufficient light for sprout vigor and growth*."

Several authors have reported that redwood seedlings do much better in full sunlight including Roy (1965), Boe (1975), and Olson et al. (1990). Green Diamond tested this relationship and verified that redwood seedlings grown in areas that had been clearcut outperform those grown in shaded environments (Figure 7).

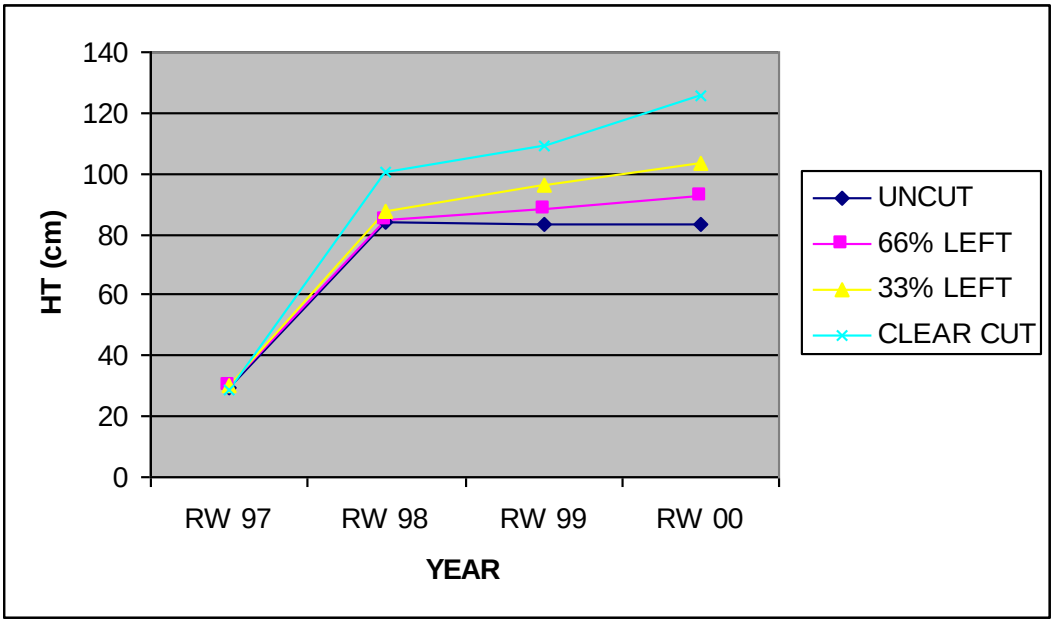

Figure 7. Results from a study on Green Diamond's timberlands by Dr. Bill Bigg. Redwood seedlings in the open grew substantially better than those in partial shade or uncut environments.

Olson et al. (1990) provide a physiological explanation as to why redwood grows so well in the open even though most researchers classify redwood as a tolerant species:

"Juvenile growth of redwood is best in full sunlight. Although redwood seedlings can endure heavy shade, growth there is slow. Photosynthetic capacity in redwood is remarkably high at low light intensities and keeps increasing as light intensity increases, much like more intolerant species."

FSC released a document that contains guidance with respect to interpreting Indicator 6.3.g.1.b (Forest Stewardship Council 2011). Most importantly it provides a definition for the term "vigorous":

Vigorous: *as used in the Indicator is intended to include consideration of fiber production, including economic and social considerations, but not to imply maximization of fiber production. Vigorous young stand development implies conditions where native tree species have access to the necessary light, water, and nutrients to grow sufficiently and maintain appropriate form class until the next entry. These conditions will vary by species and location.*

The weight of the literature indicates a substantial amount of sunlight is needed for redwood stands to develop vigorously. Although it's possible for redwoods to regenerate and survive in a stand that was partially harvested, such trees do not grow sufficiently to sustain long-term forest production at levels that approach those obtained by even-aged management. Perhaps the only outstanding question, therefore, from FSC's perspective, pertains to opening size. That is, what size clearcuts are needed to ensure that Green Diamond's young stands, which include redwood sprouts, natural regeneration, and artificial regeneration, develop over time in a manner that meets Green Diamond's objectives that include financial, social, environmental, and stewardship goals.

FSC Draft Guidance

FSC has prepared a document that provides applicants and auditors with guidance on how to achieve conformance with Part 1 of the Indicator (Forest Stewardship Council 2011):

Conformance with Part 1 of the Indicator should include:

1. *Consideration of regional silvicultural practices involving the same native species. In areas where ownerships of similar scale, commercial capacity, and site conditions are actively and successfully employing uneven-aged management for the species in question, the manager provides written and robust justification that even-aged management is required for regeneration or vigorous young-stand development. This justification includes comparisons of tree establishment and growth under even-aged and uneven-aged management.*
2. *Best available information and research on seedling/sprout survival, establishment, and growth of a young stand of native tree species.*
3. *Data from on-site, or local and equivalent, field trials measuring the relationship between management regimes (opening sizes) and survivorship and growth. These field trials may be ongoing and should be used to provide periodic feedback to management decisions. In the absence of valid and applicable data from off-site studies, on-site field trials are generally expected to be included as evidence.*
4. *Written documentation supporting conformance with the Indicator.*

Items 1, 2, and 4 were essentially covered in this paper. Item 3, however, would require that Green Diamond install field trials on its property to obtain the needed data. Such trials should be conducted with the assistance of a university professor who has expertise in the design and conduct of forest growth and yield experiments. Green Diamond is

prepared to initiate this long-term study in 2013 with the objective of measuring the relationship between opening sizes and survivorship and growth of redwood sprouts and artificial regeneration.

Conclusion

Green Diamond has a long history of managing redwood and Douglas-fir using even-aged silviculture on the North Coast of California. Over the years, we have assembled a wealth of data, conducted analyses using growth models, and surveyed the literature regarding the survival, growth, and development of redwood and Douglas-fir in this region. Based on this information Green Diamond has concluded that redwood and the other species it manages require openings for vigorous young-stand development. The size of such openings could be determined by installing field trials on Green Diamond's timberlands in cooperation with a university researcher. Green Diamond is prepared to initiate such a research effort in 2013.

Literature Cited

Adams, J., M. Cerney, and D. Thornburgh. 1996. Comparison between growth of Douglas-fir and redwood regeneration in uniform selection and group selection silvicultural systems. In Proceedings for the conference on Coast Redwood Ecology and Mgt. Humboldt State Univ., Arcata. Univ. of CA Coop. Ext., For. June 18-20, 1996. pp. 72-73.

Barrett, M. M. 1988. A model of third growth coastal redwood sprout establishment and growth under various levels of overstory removal. M.S. thesis, Humboldt State University, Arcata, California, 92 pp.

Bigg, B. 2000. Annual Report Summarizing Results from Seedling Height Study on Green Diamond's Timberlands.

Boe, K. N. 1975. Natural Seedlings and Sprouts after Regeneration Cuttings in Old-Growth Redwood. USDA Forest Serv. Res. Paper PSW-111. 17 p.

Fritz, E. 1951. Some principles governing the growing of redwood crops. Journal of Forestry 49: 263-266.

Forest Stewardship Council. 2010. FSC-US Forest Management Standard (v1.0) (complete with FF Indicators and Guidance). Recommended by FSC-US Board, May 25, 2010. Approved by FSC-IC, July 8, 2010

Forest Stewardship Council. 2011. INTERPRETATION OF FSC-US FOREST MANAGEMENT STANDARD (V1.0). Scope: Indicator 6.3.g.1.b (Pacific Coast only) – Use of Even-aged Management. Date: November 27, 2011.

Helms, J. A., and C. Hipkin. 1996. Growth of Coast Redwood under Alternative Silvicultural systems. In Proceedings for the conference on Coast Redwood Ecology and Mgt. Humboldt State Univ., Arcata. Univ. of CA Coop. Ext., For. June 18-20, 1996. pp. 74-77.

Lindquist, J. 1996. Impact of Silvicultural Systems on Redwood Regeneration. In Proceedings for the conference on Coast Redwood Ecology and Mgt. Humboldt State Univ., Arcata. Univ. of CA Coop. Ext., For. June 18-20, 1996. pp. 66-68.

McCray, K. 2010. Notice of Fire Hazard Inspection #206865.

O'Hara, K. L., and J. Berrill. 2009. Dynamics of coast redwood sprout clump development in variable light environments. Journal of Forest Research 15: 131-139.

Olson, D. F., D. F. Roy, and G. A. Walters. 1990. Sequoia sempervirens (D. Don) Endl., redwood. In: Burns RM, Honkala BH eds. Silvics of North America. Volume 1, Conifers. Agric. Handbk. 654. Washington DC: USDA Forest Service: 541B551.

Roy, Douglass F. 1965. Redwood (Sequoia sempervirens [D. Don] Endl.). In Silvics of forest trees of the United States. p. 663-670. H. A. Fowells, comp. U.S. Department of Agriculture, Agriculture Handbook 271. Washington, DC.

Rydelius, J. 2010. Information obtained during interview with Mr. Rydelius on October 27, 2010.

Smith, D. M. 1962. The Practice of Silviculture. John Wiley & Sons, Inc., New York. 578 p.